DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 225—Soil-Lime Construction

Delete Section 225 and substitute the following:

225.1 General Description

This work includes preparing and treating roadbed materials with lime to form a base, subbase, or subgrade.

Water, mix, shape, and compact the necessary material according to these requirements and with the lines, grades, and thickness indicated on the Plans.

Lime treated roadbed materials, subbases, or bases will be designated as Class A, Class B, or Class C.

The requirements of these Specifications are applicable to each course or layer, unless otherwise indicated on the Plans.

225.1.01 Definitions

General Provisions 101 through 150.

225.1.02 Related References

A. Standard Specifications

Section 109—Measurement and Payment

Section 205—Roadway Excavation

Section 209—Subgrade Construction

Section 301—Soil-Cement Construction

Section 412—Bituminous Prime

Section 810 – Roadway Materials

Section 814 – Soil Base Materials

Section 821—Cutback Asphalt

Section 880—Water

Section 882—Lime

B. Referenced Documents

GDT 19

GDT 20

GDT 21

GDT 42

GDT 59

225.1.03 Submittals

General Provisions 101 through 150.

225.2 Materials

Ensure that the soil is suitable for lime stabilization and that the materials used for stabilization meet the following requirements:

Soil	Section 810 or Section 814, as applicable
Water	Subsection 880.2.01
Lime	Subsection 882.2.02
Bituminous prime	Subsection 821.2.01
Blotter material (sand)	Subsection 412.3.05.G.3

A. Soil

Use soil that consists of materials found in the roadbed, base, subbase, or added materials as specified or directed by the Engineer. Ensure that these materials meet the requirements shown on the Plans or the pertinent Specifications for these items.

Remove the following from the soil:

- Particles of aggregate too large to pass through a 3 in (75 mm) sieve
- Roots, stumps, grass turfs, and other vegetable matter

B. Water

Use water without detrimental quantities of oil, salt, acid, alkalis, sugar, or vegetable matter. Do not use water with total inorganic solids exceeding 0.20 percent. Test non-potable water prior to use and provide test results to the Engineer. Do not begin construction until the Engineer has approved the test results.

Test according to Subsection 880.2.01.

C. Lime`

The application rate for lime will be determined from laboratory tests and provided to the Contractor prior to beginning stabilization work. Hydrated lime will be used in all tests.

D. Bituminous Prime

Use bituminous prime that consists of cutback asphalt of the following grades:

- RC-30
- RC-70
- RC-250
- MC-30
- MC-70
- MC-250

E. Blotter Material

Use blotter material (sand) that meets the requirements of Section 412.

225.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

225.3 Construction Requirements

225.3.01 Personnel

Ensure that adequate protection and safety equipment and training is provided for all personnel.

225.3.02 Equipment

A. General Equipment

Use equipment of the right size, in satisfactory mechanical condition, that can produce satisfactory results. Provide a list of proposed equipment to the Engineer prior to the beginning of construction. Provide any necessary equipment, including:

- Mechanical spreaders capable of uniformly distributing bulk lime or lime slurry to the actual application rate as shown in the Plans. Do not distribute dry lime by pneumatic pressure.
- Equipment capable of continuously mixing materials to a homogeneous blend and to a consistent depth. Weight all rollers sufficiently to accomplish the required compaction.
- Rotary-type soil mixers capable of mixing to a minimum depth of 12 inches (300 mm) and capable of injecting mix water directly into the mixing chamber with automatic sensors to monitor water application and mixing depth.
- Equipment for applying water and prime. Use a type and weight of equipment that will not damage lime-treated soil.

Do not begin construction until the Engineer has approved the proposed equipment.

B. Alternate Equipment

Alternate equipment, such as continuous or batch-type central plant or traveling mixing plants, will be approved if the equipment produces a mixture that meets this Specification.

225.3.03 Preparation

A. Prepare for Soil-Lime Construction

Prepare for soil-lime construction as follows:

1. Grade and shape the underlying foundation to the required lines, grades, and cross-section.
2. Compact the foundation to the required density specified in Subsection 225.3.05.F, "Compact Lime Layer" and Subsection 225.3.06.B, "Finishing Requirements."
3. Dry the foundation if necessary.
4. Ensure that the foundation is firm and can support the construction and compaction equipment without displacement.
5. Stabilize any soft or yielding material. If necessary, repeat this step (at no additional cost to the Department) before placing each subsequent layer.
6. Scarify and partially pulverize each layer of material to be treated to the necessary depth.
7. Remove all detrimental material from the soil according to Subsection 225.2, "Materials."

B. Test Section

The first section of each mixing operation will be a test section. The length of the test section will be the length required to use all of the lime on one truck.

Demonstrate the acceptability of the equipment and methods used and provide a standard by which to ensure the finished grade elevation and compacted thickness with this method.

1. If necessary, change the equipment, methods, or initial grade elevations based on results of the test section.
2. If changes in methods or equipment are made during the Project, construct additional test sections when directed by the Engineer.

225.3.04 Fabrication

General Provisions 101 through 150.

225.3.05 Construction

Lime-treated roadbed materials, subbases, or bases will be designated as Class A, B, or C, as follows:

A. Class A Treatment

Apply the specified percentage of lime in two equal increments according to the following steps:

1. Spread the first increment of lime.
2. Mix the material.
3. Allow the material to mellow for a minimum of 12 hours and a maximum of 72 hours.
4. Spread the second increment of lime.
5. Mix the material.
6. Compact and finish the material. See Subsection 225.3.05.F, "Compact Lime Layer," for compaction and Subsection 225.3.06.B, "Finishing Requirements," for finishing.

B. Class B Treatment

Apply the specified percentage of lime according to the following steps:

1. Spread the lime.
2. Mix the material.
3. Allow the material to mellow for a minimum of 12 hours and a maximum of 72 hours.
4. Mix the material.
5. Compact and finish the material. See Subsection 225.3.05.F, "Compact Lime Layer" for compaction and Subsection 225.3.06.B, "Finishing Requirements" for finishing.

C. Class C Treatment

Apply the specified percentage of lime according to the following steps:

1. Spread the lime.
2. Mix the material.
3. Compact and finish the material. See Subsection 225.3.05.F, "Compact Lime Layer" for compaction and Subsection 225.3.06.B, "Finishing Requirements" for finishing.

D. Apply Lime

1. General
   - Apply lime according to the rate specified by the Engineer.

- Apply lime uniformly so that the quantity applied does not vary more than +/- 10 percent of the quantity specified for each section.
- Apply lime only to areas that can be mixed in one day.
- Do not mix lime with frozen soils or with soils containing frost. Perform lime stabilization only when the air temperature is above 45 °F (7 °C) and only between April 1 and October 15, unless directed otherwise by the Engineer.
- Distribute lime at the specified rate by making repeated passes over a section until the required amount has been spread.
- After each pass, incorporate the material into the soil with mixing equipment. If necessary, add more water to the mix to accelerate mellowing.

2. Protect and Ensure Safety
   - Provide the necessary equipment and take the necessary precautions to protect operations personnel from the hazards of lime dust or slurry.
   - Prevent damage, discomfort, or inconvenience to the public or to private property while preparing and distributing lime.
3. Methods

   Spread lime on scarified areas at the specified rate. Distribute the material uniformly to avoid excessive loss.

   Choose one of the following three methods to apply lime:

   a. Dry Application with Quicklime

      Adjust the design application rate that was based on using hydrated lime, to reflect the properties of quicklime. Use the following formula to determine the application rate for quicklime:

      $$AR_Q = \frac{AR_H}{(1.32)(P)}$$

      where;

      AR_Q = Application Rate For Quicklime

      AR_H = Design Application Rate Based On Hydrated Lime

      1.32 = Ratio of molecular weights for hydrated lime (74) and quicklime (56)

      P = Certified Percent Purity Of The Quicklime

      Do not apply quicklime if the Engineer determines that wind conditions could make blowing lime hazardous to traffic, workers, or adjacent property.

      Minimize lime pockets by applying lime to shaped and rolled areas that are relatively smooth. Spread uniformly at the specified rate using a mechanical spreader approved by the Engineer.

   b. Slurry Made with Hydrated Lime

      Create a lime slurry by mixing 30 percent dry lime solids, by weight, with 70 percent water. Mix slurry in agitating equipment, and continue to agitate until arriving at the roadbed. Spread slurry on the scarified area with distributing equipment.

   c. Slurry Made by Slaking Quicklime

      Create a lime slurry by slaking quicklime using special equipment at or near the Project site. Obtain the Engineer's approval for all equipment and procedures before work begins

E. Mix Lime

1. General

   Maintain the moisture content of the material at its specified optimum or not more than 5 percent over the optimum, at all times.

   Add water during mixing if necessary, even if the material has the optimum moisture content to sustain the chemical reaction between lime and water.

   Mix the material the same as for "Dry Application" or "Slurry Application" unless indicated otherwise.

   a. Immediately after applying the lime:
      1) Mix to the required depth and width.
      2) If the depth to be treated, as shown on the Plans, is more than 12 in (300 mm) compacted, treat in approximately equal layers of not more than 12 in (300 mm) deep.
      3) When multi-layer construction is required, blade the upper layers of the compacted soil in windrows outside the area to be treated until the lower layer is mixed, compacted, and approved by the Engineer.
      4) Blade each successive layer back into place, shape and treat it with lime, mix, compact and shape to typical section. Include the cost of this manipulation in the bid price.
   b. Control scarifying and mixing to provide uniform depth. Make the crown of the undisturbed soil underneath conform as closely as possible to the crown of the finished course.
   c. Until the lime is incorporated or mixed, allow only spreading, watering, or mixing equipment to drive over the section being processed.
   d. Determine bulking factors from the dry weight of laboratory-tested raw and lime treated soils. Furnish a finished course of lime treated material that conforms to the specified thickness and surface requirements in the Plans.

2. Mix Lime (Initial)

   a. Class A or Class B Lime Treatment
      1) Incorporate lime and water with rotary mixers until uniform. The mixture must pass through a 2 in (50 mm) sieve.
      2) Add the amount of water necessary to produce a moisture content of no less than 0 percent below the mixture's optimum moisture content or no more than 5 percent above optimum moisture content. See GDT 19.
      3) After mixing is complete, reshape the treated course to the approximate line, grade, and typical section.
      4) Seal with a light, pneumatic-tired roller and other approved equipment, as necessary.
      5) Mellow for a minimum of 12 hours and a maximum of 72 hours.
   b. Class C Lime Treatment
      1) Incorporate lime and water with rotary mixers until uniform. Continue to mix and add water until obtaining a homogeneous mixture of soil, lime, and water that is satisfactory to the Engineer.
      2) After mixing and applying water, ensure that 100 percent of the material by dry weight passes a 1.0 in (25 mm) sieve and 60 percent by dry weight passes a No. 4 (4.75 mm) sieve.

3. Mix and Pulverize Lime (Final)

   The following applies to Class A and Class B lime treatments only.

   a. After the required mellowing period, scarify the layer.
   b. After a Class A treatment, add the second application of lime.
   c. Remix the layer as prescribed in the initial mixing operations, adding water as necessary.

d. Continue mixing until 100 percent of the material by dry weight, exclusive of gravel and stone, passes a 1.0 in (25 mm) sieve and 60 percent passes a No. 4 (4.75 mm) sieve.

e. Ensure that the percent of moisture is at or above the laboratory specified optimum moisture.

f. If mixing cannot be completed in one day, seal the surface of the layer with a rubber-tired roller. Continue the process the next day, weather permitting.

F. Compact Lime Layer

Compact the material according to the following requirements and to Subsection 225.3.06.B, "Finishing Requirements" for finishing.

1. Class A and B Lime Treatments

   Compact the mixture within 4 hours after completing the final mixing. Maintain the material at a moisture content within ±2 percent of optimum.

2. Class C Lime Treatment

   Compact the mixture immediately after completing the first and only mixing. Maintain the material at a moisture content within ±2 percent of optimum.

3. Class A, B, and C Treatments

   a. Complete compaction operations during one working day.

   b. Keep the moisture content of the material uniform when compacting. Maintain the material at optimum moisture content or up to two percent over the optimum content.

   c. Compact uniformly and continuously, beginning at the bottom. Use sheepsfoot-type rollers. Continue until the entire depth of the mixture is compacted to the required density specified in Subsection 225.3.06.A.

   d. Immediately correct depressions or soft spots that develop in the compacted areas with the following methods:

      1) Scarify the area.

      2) Add lime when required.

      3) Remove the material when required.

      4) Reshape and compact.

   e. Stop compaction and remove the sheepsfoot-type roller when a layer of loose soil not exceeding 1 in (25 mm) remains.

   f. In addition to the requirements specified for density, compact the full depth of the mixture to the extent necessary for it to remain stable under construction equipment.

G. Cure Lime (Final)

1. General

   a. After the lime-treated soil has been finished as specified in Subsection 225.3.06.B, keep it moist for 7 days.

   b. Lime stabilized subgrade or embankment may be cured by applying water to maintain the course moist during curing.

   c. To protect a lime-stabilized base, subbase, or shoulder course, apply bituminous prime material (see Subsection 225.2.D) according to Section 412.

   d. Apply the prime as soon as possible, but not later than 24 hours after completing the finishing operations, unless delayed by wet weather. If delayed, apply prime as soon as the surface is sufficiently dry.

   e. Ensure the lime-treated soil surface is free of all loose and extraneous material and that it contains sufficient moisture to prevent excessive penetration of the bituminous material.

   f. If directed by the Engineer, sweep the lime-treated soil clean of loose material before applying the prime.

2. Apply the Prime

a. Apply the bituminous material uniformly to the surface of the lime-treated soil at the rate of 0.15 to 0.30 gal/yd² (0.70 to 1.4 L/m²).

b. Properly maintain the material during the entire curing period so that all of the lime-treated soil will be covered effectively during this period.

c. Complete curing prior to placing subsequent layers of material.

3. Protect Lime Layer

a. If necessary, open completed sections of the lime-treated soil to lightweight local traffic. Make sure the curing is not impaired and that the treated sections have hardened sufficiently to prevent marring or distorting the surface.

b. Use construction equipment on the lime-treated soil only to discharge material into the spreader during base or paving operations or except as may be permitted for embankment construction.

225.3.06 Quality Acceptance

A. Density Requirements

After shaping the mixture to line, grade, and cross- section specifications, roll the course until uniformly compacted as determined by GDT 19. Use the percentages of maximum dry density in the following table. Determine the in-place density according to GDT 20, GDT 21, or GDT 59, as applicable.

All base, subbase, or shoulder courses	100%
Top 1 ft (300 mm) of embankment (subgrade)	100%
To within 1 ft (300 mm) of the top of the embankment	95%

B. Finishing Requirements

Ensure that the surface of the completed lime-stabilized layer conforms to the lines, grades, and cross- sections shown on the Plans or established by the Engineer and meets the following characteristics:

- Uniform lime mixture
- Smooth
- Dense
- Well-bonded
- Unyielding
- Free of cracks or loose material

Ensure that surface requirements meet the following Specifications:

Subgrade	Subsection 209.3.05.E.
Base, subbase, or shoulder course	Section 301

C. Thickness

If necessary, reconstruct the course or add lime to the course at no additional cost to the Department.

1. Determine the thickness of the lime-stabilized layer, according to GDT 42, at intervals not to exceed 500 ft (150 m).
2. Do not allow the thickness of the entire layer to vary more than 1 in (25 mm), plus or minus, from the thickness shown on the Plans.
3. Immediately reconstruct any section deficient by more than 1 in (25 mm) according to this Specification and the Plans.

4. Add additional lime to correct the deficiency of any section exceeding the 1 in (25 mm) tolerance. Remix to the specified depth and width according to this Specification and the Plans.

225.3.07 Contractor Warranty and Maintenance

Perform the following work at no cost to the Department. Repeat this work as often as necessary to keep the lime-treated soil intact.

- Maintain the lime-treated soil in good condition until The Work is completed and accepted.
- Maintain a smooth surface on the course by blading.
- Immediately repair any defects that occur.

225.4 Measurement

A. Soil-Lime Material

If it is necessary to add other material to the roadbed, or to build the base or subbase entirely with new material, soil-lime material is measured by loose volume cubic yard (meter), as specified in Section 109.

B. Soil-Lime Treated Roadbed, Subbase, and Base Course

If payment is specified by the square yard (meter), soil-lime treated roadbed, subbase, and base course are measured with the methods used for soil-cement specified in Section 301.

C. Lime

- Lime is measured by the ton (megagram).
- If quicklime (Ca0) is slaked on the job in an approved mixing tank to produce a lime slurry, the pay quantity for lime is measured in ton (megagram) of hydrated lime. The pay quantity is calculated using the certified lime purity for each truckload as follows:

  Total Weight of Hydrated Lime Produced, ton (Mg) = (A x B x 1.32) + A (C)

  Where:

  A = actual quicklime delivered

  B = certified % purity

  C = % inert material

  1.32 = ratio of molecular weights for hydrated lime (74) and pure quicklime (56)
- If quicklime is spread on the roadbed in a dry application, it is measured by the ton (megagram) based on invoice weight.
- The formula for converting quicklime to hydrated lime does not apply for dry applications.

D. Prime

Bituminous prime is not measured for separate payment. Application will be according to Section 412.

E. Unsuitable Material

Unsuitable materials removed from the roadbed are measured according to the Earthwork Item in the Contract.

225.4.01 Limits

General Provisions 101 through 150.

225.5 Payment

A. Soil-Lime Material

If material is mixed on the job, it may be necessary to add other materials to the roadbed or to build up the base or subbase entirely with new materials. Any additional soil-lime material will be paid at the Contract Price per square yard (meter) or per cubic yard (meter) when in place and accepted.

Payment will be full compensation for the following:

- Shaping and compacting the existing roadbed
- All materials except lime
- Loading and unloading materials
- Hauling materials
- Crushing, processing, mixing, spreading, watering, compacting, and shaping materials
- Maintenance
- All other incidentals necessary to complete the work

B. Soil-Lime Treated Roadbed Base and Subbase Course

A course of soil-lime treated roadbed base and subbase will be paid for at the Contract Price per square yard (meter) when in place and accepted. Payment will be full compensation for the following:

- Preparing the roadbed
- Mixing on the road
- Shaping, pulverizing, watering, and compacting materials
- Repairing all defects
- Maintenance

C. Pre-mixed Soil-Lime Treated Base and Subbase Course

A course of pre-mixed soil-lime treated base and subbase will be paid for at the Contract Price per ton (megagram) or per square yard (meter) when completed, in place and accepted.

Payment will be full compensation for the following:

- Shaping and compacting the existing roadbed
- All materials except lime
- Loading and unloading materials
- Hauling materials
- Crushing, processing, mixing, spreading, watering, compacting, and shaping materials
- Maintenance
- All other incidentals necessary to complete the work.

D. Lime

Only lime in the finished course or courses will be paid at the Contract Price per ton (megagram). Payment will be full compensation for furnishing, hauling, and applying the material.

Payment will be made under:

Item No. 225	Soil-lime material—including material and haul	Per cubic yard (meter)

Item No. 225	Soil-lime treated (roadbed, base, subbase or shoulder course), class ____, thickness____	Per square yard (meter)
Item No. 225	Lime	Per ton (megagram)

225.5.01 Adjustments

No payment will be made for lime used to correct defects due to faulty equipment or negligence.

Payment will not be made for any lime spread and exposed for four hours or more prior to mixing. Treat such areas again with the full required rate of application.

Add lime, at no additional cost to the Department, to any section on which washing or blowing prior to mixing caused excessive lime loss.

Reconstruct areas, at no cost to the Department, on which lime-treated soil was constructed but not covered with a layer of pavement, base, or other construction material during the same construction season.

The Engineer will test each section as it is completed. Scarify, moisten, rework, and compact any section with a density less than the specified requirements according to the requirements of these Specifications and at no additional cost to the Department.

No payment will be made for lime application exceeding the 10 percent plus tolerance. When the quantity applied is deficient by more than 10 percent, apply additional lime prior to mixing at the Contractor's expense.